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IS 12043-2 (1987): Electrical Connectors for Aircraft, Part 2: Tests [TED 14: Aircraft and Space Vehicles]

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Indian Standard "पुनर्मुख नियम"

SPECIFICATION FOR "RE-AFFIRMED 1992"
ELECTRICAL CONNECTORS FOR AIRCRAFT

PART 2 TESTS

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BUREAU OF INDIAN STANDARDS
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Indian Standard
SPECIFICATION FOR
ELECTRICAL CONNECTORS FOR AIRCRAFT
PART 2 TESTS

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Indian Standard

SPECIFICATION FOR ELECTRICAL CONNECTORS FOR AIRCRAFT

PART 2 TESTS

0. FOREWORD

0.1 This Indian Standard (Part 2) was adopted by the Indian Standards Institution on 25 March 1987, after the draft finalized by the Aircraft Electrical Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The objective of this standard is to specify the requirements and methods of tests for electrical plug and socket connectors for aircraft.

0.3 Part 1 of this standard specifies the design the features and service condition of electrical connector for use in aircrafts. This standard (Part 2) shall be read in conjunction with Part 1 of this standard.

0.4 This standard is not intended for a particular type of connector. For a specific range of connectors to be considered as being in conformity with this standard, a detailed specification for the range may be referred.

0.5 In preparing this standard, assistance has been derived from the following:

ISO : 2100-1972(E) 'Tests for aircraft electrical plug and socket connectors' issued by International Organization for Standardization.

MIL-C-005015(F) 'Electrical connectors, aircraft' issued by USA, Department of Defence.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 2) specifies the test procedures and performance requirements for aircraft electrical connectors.

1.2 This standard applies to types of connectors designed to use crimped, soldered and welded contacts accommodating aircraft cables.

2. TERMINOLOGY

2.0 For the purpose of this standard the following definitions, in addition to those given in **2** of Part 1 of this standard, shall apply.

2.1 Type Tests — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general qualities and design of a given type of connector.

2.2 Acceptance Tests — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

2.3 Routine Tests — Tests carried out on each connector to check the essential requirements which are likely to vary during production.

3. MATERIAL AND CONSTRUCTION

3.1 The requirements of **4** of Part 1 of this standard shall apply.

4. MARKING

4.1 Each connector shall be marked with the following:

- a) Number of this standard;
- b) Manufacturer's name or trade-mark;
- c) Class and part number; and
- d) Rating in ampere and volts, ac or dc.

4.1.1 Aircraft electrical connectors may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

5. TESTS

5.0 General

5.0.1 Unless otherwise specified, all tests shall be conducted at standard atmospheric conditions given below:

Temperature	:	15 to 35°C
Relative humidity	:	45 to 75 percent
Air pressure	:	86 to 106 kPa

5.0.2 When individual contact tests are specified and there are more than six contacts of the same rating contained in the connector, the number tested shall be at least six. These shall be selected from those having the least nominal spacing between each other; or the least nominal spacing between contacts and the metal housing.

5.0.3 At the conclusion of the tests, all the specimens and accessories shall be examined as to the legibility of the marking excepting those specimens which have been subjected to the fireproofness test.

5.1 Classification of Tests

5.1.1 Type Tests — The following shall constitute the type tests:

- a) Visual examination (*see 5.2*);
- b) Engagement and disengagement force (*see 5.3*);
- c) Contact potential difference (*see 5.4*);
- d) Insulation resistance (*see 5.5*);
- e) Shell continuity (*see 5.6*);
- f) Sealing (*see 5.7*);
- g) Contact holding force (*see 5.8*);
- h) Contact retention (*see 5.9*);
- j) Low temperature handling (*see 5.10*);
- k) Immersion-low air density (*see 5.11*);
- m) Resistance to fluids (*see 5.12*);
- n) Voltage proof (*see 5.13*);
- p) Vibration (*see 5.14*);

- q) Thermal shock (*see 5.15*);
- r) Endurance at maximum temperature (*see 5.16*);
- s) Resistance to damage by test prod (*see 5.17*);
- t) Mechanical endurance (*see 5.18*);
- u) Magnetic interference (*see 5.19*);
- v) Climatic (*see 5.20*);
- w) Acceleration (*see 5.21*);
- x) Insert retention in shell (*see 5.22*);
- y) Fireproofness (Class F only) (*see 5.23*); and
- z) Salt spray (*see 5.24*).

5.1.2 Acceptance Tests — The following shall constitute the acceptance tests:

- a) Visual examination (*see 5.2*);
- b) Engagement and disengagement force (*see 5.3*);
- c) Contact potential difference (*see 5.4*);
- d) Insulation resistance (*see 5.5*);
- e) Shell continuity (*see 5.6*);
- f) Sealing (*see 5.7*);
- g) Contact holding force (*see 5.8*)
- h) Contact retention (*see 5.9*);

NOTE — The number of samples and the sequence of tests for acceptance tests shall be as agreed by the manufacturer and the purchaser.

5.1.3 Routine Tests — The following shall constitute the routine tests:

- a) Visual examination (*see 5.2*);
- b) Engagement and disengagement (*see 5.3*);
- c) Contact potential difference (*see 5.4*);
- d) Insulation resistance (*see 5.5*); and
- e) Shell continuity (*see 5.6*);

5.2 Visual Examination — The connector shall be examined for conformity with 3 and 4. The quality and workmanship shall be satisfactory when visually examined.

5.3 Engagement and Disengagement Forces — With the fixed items mounted in the normal manner, the correct mating item shall be fully engaged and disengaged in the normal manner. The forces of engagement and disengagement shall be within the limits declared by the manufacturer.

5.4 Contact Potential Difference — With the connectors fully engaged, the applicable test current shall be passed through each contact to be tested until stable conditions are obtained. The test current shall be the dc rated current in accordance with an agreed bunch rating for the cable used. The open circuit voltage of the source shall not exceed 2·5 V. The contact potential difference of each contact shall measure within the limits specified by the manufacturer.

5.5 Insulation Resistance — The unmated specimen shall be mounted in the normal manner. The insulation resistance shall be measured at 500 V dc for 1 minute between each contact and all other contacts connected together and to the housing and mounting plate. The value of insulation resistance thus measured shall be not less than 5G Ω .

5.6 Shell Continuity — Using a dc voltage source, the open circuit voltage of which does not exceed 2·5V, a current of 1A shall be passed from the cable accessory on one side, through the engaged connector to the cable accessory on the opposite side. The voltage drop between the extremities of both cable accessories shall not exceed 12·5 mV.

5.7 Sealing

5.7.1 Non-hermetic Connectors — The test shall be conducted at the declared minimum temperature, at normal temperature; and at the declared maximum temperature. The connectors shall be suitably mounted and a differential pressure of 96·5 to 103 kN/m² shall be applied in both directions across all seals. The leakage rate shall not exceed 15 cm³/h expressed at normal temperature and pressure.

5.7.2 Hermetic Connectors — The test shall be conducted at normal temperature only. The connector suitably mounted on a sealed container shall be subjected to a differential pressure of 96·5 to 103 kN/m² in both directions. The leakage rate shall not exceed 1×10^{-7} cm³/s.

5.8 Contact Holding Force — The test shall be conducted on six female contacts of each size. The test contacts shall be preconditioned by hand, ten times, using a gauge of maximum permitted pin diameter.

The connectors shall be mounted vertically with the mating face underside. Gauges A and B, each having a surface finish 0·15 to 0·25 μm and of specified mass, shall be inserted in each socket to simulate maximum and minimum diameter pin contacts. The female contacts shall retain gauge A and not retain gauge B.

Contact Size	Gauge A			Gauge B		
	ϕ	Engaged Length	Mass g	ϕ	Engaged Length	Mass g
22 and smaller	<i>Min</i>	<i>Min</i>	14	<i>Max</i>	<i>Max</i>	113
20	<i>Min</i>	<i>Min</i>	21	<i>Max</i>	<i>Max</i>	170
16	<i>Min</i>	<i>Min</i>	57	<i>Max</i>	<i>Max</i>	567
12	<i>Min</i>	<i>Min</i>	71	<i>Max</i>	<i>Max</i>	850

5.9 Contact Retention — Using appropriate tool, two widely spaced contacts shall be inserted and removed ten times on the connector. The connector shall be mounted vertically and the load as given below shall be axially applied to the wires attached to the contacts for 5 minutes.

Contact Size	Force (N)
11 and smaller	45
20	90
16	110
12	135

The above procedure shall be repeated on two other pin contacts applying the forces in the opposite sense by an approved means. Movement of the contacts relative to the insert shall not exceed 0·4 mm at any time.

5.9.1 Using appropriate tools, 50 percent of the contacts or not less than 3 contacts shall be inserted in both plugs and sockets, after removing all the contacts. The insertion force of the tool with or without a contact fitted shall not exceed 67 N. The force necessary to remove the tool, wire and contact assembly shall not exceed 45 N.

5.10 Low Temperature Handling — The engaged connectors shall be maintained at a temperature of $-40 + 2^\circ\text{C}$ for 2 hours. The plugs and sockets shall be disengaged at the end of this period and while the specimen is still at the controlled temperature, separation shall be achieved by hand without recourse to tools. There shall be no sign of damage on visual examination.

5.11 Immersion Low Air Density — The connectors shall be tested as mated sets. The back of the fixed items shall be suitably sealed and the individual cable leads shall be separated widely. The connectors shall be immersed in a container of 5 percent sodium chloride solution. The container shall be placed in a suitable chamber with the free ends of the cable terminated inside the chamber but not immersed. The air pressure inside the chamber shall be reduced to that equivalent to an altitude of 31 000 m and maintained at this value for 30 min. The chamber shall then be allowed to come to normal atmospheric pressure. This procedure shall be repeated thrice. At the end of the third cycle, and while the connectors are still submerged, they shall be subjected to insulation resistance test (*see 5.5*). The value of insulation resistance shall be not less than $100 \text{ M } \Omega$.

5.12 Resistance to Fluids — The samples for this test, while disengaged, shall be exposed to standard atmospheric conditions (*see 5.0.1*) for at least 24 hours. Separate samples shall be used for each fluid. The fluid shall be at the temperature stated, or at the maximum temperature for the connector, whichever is the lesser. When necessary, a break of not more than 3 days may be made at the end of any cycle.

5.12.1 The disengaged specimens shall be immersed for a period of 15 to 20 min. When greases is specified, liberal smearing over all exposed surfaces of the inserts will suffice. The specimens shall be engaged and disengaged immediately after removal from the solvent. Full engagement shall be achieved by hand without recourse to tools.

The specimens shall then be allowed to remain disengaged under normal conditions for a period of 15 to 24 h.

The specimens shall then be engaged and subjected to the maximum working temperature of the connectors for a period of 7·0 to 7·5 h at the end of which they should be disengaged and engaged. Full engagement shall be achieved by hand without recourse to tools.

The above sequence shall be repeated for a further four cycles.

5.13 Voltage Proof — Engaged specimens shall be placed in an altitude chamber, taking care to separate cable leads as widely as possible.

Connections outside the chamber shall be terminated. The pressure shall then be reduced within the chamber to the equivalent of an altitude of 31 000 m, and maintained at this condition for at least 2 h at the end of which period, while the condition still obtains, a test potential of 700 V dc or 500 V ac (rms) shall be applied for a period of 1 min between each contact and all other contacts connected together and to the shell. Leakage current shall not exceed 10 μ A.

The components shall then be disengaged and fitted with protective caps and the test repeated.

5.14 Vibration — Sample for this test shall include engaged pairs and disengaged but capped fixed connectors. Fixed connectors shall be secured to the vibration table by their normal mounting arrangement.

Means shall be provided for continuously monitoring the resistance of all, or of six engaged contacts, whichever is the lesser, wired in series. The contacts selected shall include the centre contact and others extending radially as widely as possible. The resistance of the chain shall be monitored continuously while passing a nominal 1 A at an open circuit voltage not exceeding 2.5 V dc.

The samples shall be subjected to the vibration resonance search test detailed in IS : 8252 (Part 14)-1981*. During this entire period, no change in resistance shall exceed : 10 m Ω for a period of more than 1 μ s.

At the conclusion of the resonance search test and at the conclusion of any resulting 10 h endurance test (should such be necessary), the items shall be visually examined. There shall be no mechanical damage or loosening of parts.

5.15 Thermal Shock — Engaged connectors shall be subjected to five cycles of the following:

The sample shall be kept for not less than 1 h in a chamber maintained at the declared minimum temperature $\pm 5^{\circ}\text{C}$. Within a period not exceeding 2 min, the sample shall be transferred to a chamber maintained at the declared maximum temperature $\pm 5^{\circ}\text{C}$ where the specimen should remain for not less than 1 h.

At the conclusion of the fifth cycle, the sample shall be allowed to return to normal conditions and then disengaged. There shall be no obvious material deterioration.

*Environmental tests for aircraft equipment: Part 14 Mechanical vibrations.

5.16 Endurance at Maximum Temperature — Engaged connectors shall be subjected to the declared maximum temperature $\pm 5^{\circ}\text{C}$ for a period of 1 000 h.

At the end of this period and while the sample is still at maximum temperature, the insulation resistance shall be measured (see 5.5). The value shall be not less than $200 \text{ M } \Omega$. The plug and socket shall exhibit no obvious material deterioration.

5.17 Resistance to Damage by Test Prod — A standard test prod of nominal pin diameter shall be put into the socket contact, while in the insert, to the minimum, mean and maximum declared engagement positions. At each of these depths, the following appropriate bending moment shall be applied to the prod about the inserted end and rotate the socket assembly in one direction through 360° so that a uniform force is applied around the inside surface of contact. Contacts may be locked against rotation.

Size	<i>Bending Moment ± 10 percent</i>
	N.m
22 and smaller	0.014
20	0.056
16 and 12	0.226

There shall be no mechanical damage or loosening of parts when visually examined.

5.18 Mechanical Endurance — The mating connectors shall be fully engaged and disengaged 500 times using the normal means (coupling devices such as bayonet or screwed coupling rings). The maximum number of engagements per minute should be 15. At the end of the test, there shall be no mechanical damage or loosening of parts, when visually examined.

5.19 Magnetic Interference — This test is only applicable to those types containing ferrous material. Samples for this test are to be fully engaged but should not carry current.

Compass safe distance shall be measured as described in IS : 8252 (Part 18)-1978*. Safe distance shall not exceed 127 mm.

*Environmental tests for aircraft equipment: Part 18 Magnetic influence.

5.20 Climatic — The sample for this test shall include specimens which are disengaged but capped. All leads may be separated as widely as practical.

Throughout the climatic tests (except during measurements) odd-numbered contacts shall be connected together, and even-numbered contacts connected together and to the shell. During test, there should be a potential difference of 350 V dc between these two circuits which should be monitored throughout the test. There shall be no voltage breakdown during the whole period of the test.

5.20.1 Humidity Temperature and Pressure — The samples shall be subjected to the combined humidity, temperature and pressure test detailed in IS : 8252 (Part 2)-1980*.

5.20.2 Fungus Growth — The samples shall be subjected to the fungus growth test detailed in IS : 8252 (Part ...)†.

At the end of the 28 days, the items shall be removed from the test chamber and allowed to recover at normal temperature and pressure within 1·5 to 2·0 h.

After removal from the chamber, the items shall be visually examined. There shall be no external deterioration which would affect service use and no mould growth visible to the naked eye.

5.21 Acceleration — The engaged specimens shall be subjected to the acceleration and crash landing tests detailed in IS : 8252 (Part 15)‡. There shall be no evidence of discontinuity, during test.

There shall be no loosening of parts likely to impair service use, when visually examined at the end of this test.

5.22 Insert Retention

5.22.1 Torsional — The cable loom shall be secured at a point 150 mm from the rear face of the insert. The unmated plug or socket shall then be rotated through 90°. There shall be no permanent displacement of the insert.

The above test shall be repeated with rotation in the opposite direction. There shall be no permanent displacement of the insert.

*Environmental test for aircraft equipment: Part 2 Temperature, pressure and humidity.

†Mould growth (*under preparation*).

‡Constant acceleration (*under preparation*).

5.22.2 Axial — The appropriate axial force as stated below, at a rate of approximately 45 N per second, shall be applied to the mating face of the specimen and maintained for at least 1 min.

<i>Shell Size</i>	<i>Applied Axial Force</i>
	N
8-10-12	132
14-16-18	245
20-22-24	385
28-32-36	410

There shall be no permanent displacement of the insert, when tested with the load applied to the opposite face.

5.23 Fireproofness (Applicable to Fireproof Types Only) — The engaged components shall be mounted on a 300 mm square vertical steel sheet, 0·45 mm thick which has been strengthened by a stiffening plate 0·7 mm thick extending 6 mm beyond the profile of the connector. Two calibrated gas torches shall be positioned in a horizontal plane, each at 45° to the axis of the plug and on the same (free member) side of the steel sheet so that the components are wholly enveloped in flame, the temperature of which, measured 6·4 mm from the assembly, shall be not less than 1 100°C.

This test shall be continued for not less than 20 min.

Concurrently, the assembly shall be vibrated continuously at 33 Hz with a minimum amplitude of 1 mm with total excursion 2 mm.

All contacts shall be so wired that continuity between engaged contacts, and any breakdown to shell or between any other contacts, is indicated. All circuits shall function for at least 6 min and no flame occur on the safe side throughout the test.

5.24 Salt Spray — The samples for the test shall include engaged specimens and disengaged but capped specimens shall be subjected to a salt corrosion test in accordance with IS : 8252 (Part 10)-1979*.

The test shall be continued for a period of approximately 1·5 h, after which the specimens shall be maintained at a temperature of $35 \pm 2^{\circ}\text{C}$ and a relative humidity of 90 to 95 percent for a period of 7 days.

*Environmental tests for aircraft equipment: Part 10 Salt mist.

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The above cycle of treatment shall be repeated three times. At the end of 28 days, the specimens shall be visually examined and shall be subjected to tests specified in **5.6** and **5.3**.

There shall be no corrosion or deterioration sufficient to impair service use.

The values of potential drop obtained shall not be greater than 25 mV.